73/2

FISHING INDUSTRY RESEARCH TRUST ACCOUNT

REPORT ON PROJECT 1974/75

1. Title of Proposal: Laboratory rearing of commercial scallops

2. Name of Applicant: Department of Agriculture, Tasmania

3. Division, Department or Section: Fisheries Division

4. Proposal: To investigate laboratory rearing of the Tasmanian commercial scallop, Pecten meridionalis, primarily with a view to development of commercial hatchery rearing and secondarily to provide information essential to ecological studies of this unknown phase of the scallop's life history.

5. Name of person responsible for the programme: Trevor G. Dix, B.Sc. (Hons), Ph.D., Officer-in-Charge, Fisheries Laboratory, Taroona.

6. Qualifications of Staff Employed on the Programme: Marine Biologist, Trevor G. Dix; Technical Officer and Technical Assistant.

7. Location of Operations: Fisheries Research Laboratory, Crayfish Point, Taroona. Collections of adult stock were made in Coles Bay, East Coast, D'Entrecasteaux Channel and Bass Strait.

Introduction

The project which broadly aimed to assess the hatchery potential of Pecten meridionalis began in 1973 with the objectives of:

(1) to expand study into the techniques of spawning induction;

(2) raise scallops under laboratory conditions with emphasis on growth and survival under different temperature and feeding regimes; and

(3) provide details for identification of the series of planktonic larval stages as background information for future larval field ecology studies.

Objective (3) was realised and a separate publication (Dix and Sjardin 1975) describes larvae of P. meridionalis.

Rearing procedures involve the following phases: collection of adult stock and conditioning these for spawning; spawning induction and fertilisation; rearing of embryos and larvae; (including provision of algal food for the larvae); collection and rearing of spat. The last phase was not a part of the present project. For guidance on future hatchery work at Taroona a section of the Laboratory and its water supply is added.

Laboratory and Water Supply

The Fisheries Research Laboratory, on the west bank of the Derwent Estuary 8 km downstream from Hobart, receives a continuous supply of sea-water from the estuary.

Mean monthly temperatures for laboratory water are similar to those found in Tasmanian coastal waters, ranging from 10-11°C in July or August to 17-18°C in February. Monthly mean salinities range generally from 32-34 ppt. Lower readings are taken occasionally after periods of heavy rainfall. pH levels usually range from 7.5-8.1.

It is well known that shellfish in the Derwent Estuary contain large concentrations of heavy metals, particularly cadmium and zinc. This led to concern about metal levels in the Laboratory water supply. Tests conducted in December/January 1973/74, November/December 1974 and March, April and May 1975 indicated that the levels of zinc, cadmium, copper, lead and mercury more closely resembled those of coastal waters than those in surface waters further upstream in the Derwent.

Adult Stock and Conditioning

Adult stock were collected from Oyster Bay, Spring Bay (East Coast), Bass Strait and D'Entrecasteaux Channel. Stock suitable for spawning were gathered both by dredging and by diving; the former method was logistically simpler and with the research vessel in the area conducting other projects, regular samples were taken from Spring Bay during 1974 and 1975.

Such regular field collections held in running water aquaria at Taroona presented the most reliable method for ensuring a supply of parents for spawning. Experiments seeking to manipulate gonad development in the laboratory were not a great success. Although natural gonad ripening occurs with falling water temperatures, maintaining scallops in chilled water did not hasten gonad development. Chilling ripe scallops did, however, prevent them from spawning for periods up to several weeks.

In spite of the lack of success in manipulating gonad development over extended periods spawning was achieved for six months of the year using regular collections maintained in aquaria.

Induction of spawning was simple in ripe scallops. Raising the temperature quickly to about 20°C caused scallops to spawn (see Pl 9 in Dix 1975). This occurred usually within 2-3 hours of raising the temperature and eggs and sperm were released jointly or severally. Close observation of spawning scallops and transfer to fresh spawning containers allowed eggs to be fertilised by the necessary small numbers of sperm.

Rearing of Embryos and Larvae

From a situation in 1973 of virtually no predictability of normality in embryonic development, batches of several millions of shelled larvae with more than 80% normal can now be produced routinely. Essential requirements elucidated during the study were that the spawned eggs must be mature (round quickly after spawning) and fertilised by low numbers of sperm. Eggs must be passed through sieves to remove clumped eggs and debris. Antibiotics are placed in the rearing containers with the fertilised eggs to prevent bacterial build-up. Two million eggs are placed in each 90 litre rearing container filled with filtered and sterilised water. Although the temperature and salinity of the rearing water can affect the normality of embryonic development, these conditions were favourable in Taroona water.

After embryonic development, the newly shelled larvae require regular feeding. A variety of unicellular algae including Isochrysis, Monochrysis and Tetraselmis were cultured for larval food. Algal culture techniques, similar to those developed in overseas laboratories, were labour intensive but routine.

The young larvae were fed a mixture of Monochrysis and Isochrysis which resulted in better growth than that achieved with either species alone. As the larvae grew, Tetraselmis was included in the food mixture. Experiments conducted during 1975 showed that no marked improvement in larval growth was obtained by centrifuging algae from their culture medium before feeding the larvae. Centrifuging did, however, enable a number of quantitative feeding experiments to be conducted with greater ease.

Water in the culture containers was replaced with filtered, ultra-violet sterilised seawater every 2-3 days when the larvae were collected on sieves of appropriate mesh sizes. Such sieving, necessary to cull stunted or dead individuals from the cultures, demands that larval cultures grow at a reasonable rate in order to achieve the intended separation.

Despite the fact that fair numbers of larvae were raised to metamorphosis at the Laboratory, difficulty was experienced in growing large numbers of umboned larvae to metamorphosis. Utilisation of higher rearing temperatures in 1975 (17-18^{o} vs 12-15^{o}C) gave better growth of the younger larvae but slowing of growth and increasing mortality still occurred in the older larvae. Addition of Tetraselmis to the food mixture for older larvae and a daily feeding regime gave marginal growth and survival improvements.

Pests and diseases (ciliates, amoeba, bacteria) did not appear a problem when larvae in cultures were healthy and growing rapidly. They did become troublesome in the older larval cultures and difficulty was experienced in achieving effective chemical 'dip' techniques which aimed to kill pests but not larvae. Formalin and sodium hypochlorite were the most promising 'dips' but great care had to be taken with treatment times and concentrations.

Conclusions

Techniques for inducing spawning and raising large numbers of young, apparently healthy larva were successfully developed in the project. Small quantities (several thousand) of larvae were raised to metamorphosis providing details for identification of all planktonic larval stages. If culture operations using spat collected in the field are contemplated, the descriptive work should allow identification of larvae from plankton collections for essential spat prediction work.

The project largely achieved its stated objectives although it was disappointing not to achieve predictability of rearing older larvae to spat. It is believed that the techniques are, in themselves, appropriate. They are similar basically to those found successful in overseas laboratories and they have been used with some success on other species at Taroona, viz. the queen scallop (Dix in prep.) and the native oyster (Dix in press).

The commercial scallop, with its relatively long larval life, may have certain inherent difficulties of rearing.

11. References

Dix, Trevor G. 1975: Farming the Sea Pp 93-100 In "Resources of the Sea" A symposium arranged by the Royal Society of Tasmania, November 1974 (M.R. Banks and T.G. Dix Eds)

Dix, Trevor G. (in press): Laboratory rearing of larval Ostrea angasi in Tasmania, Australia. J. Malacol. Soc. Aust.

Dix, Trevor G. (in prep.): Larval development of the queen scallop, Equichlamys bifrons.

Dix, Trevor G. and M.J. Sjardin (1975): Larvae of the commercial scallop, Pecten meridionalis from Tasmania, Australia. Aust. J. mar. Freshwat. Res. 26: 109-12.